

REMARKS

By the present amendment, claims 3-6 and 16-17 are pending in the application. Claims 16 and 17 are independent claims.

Claim Amendments

Independent claims 16 and 17 have been amended by the present amendment to clearly point out that the metal balls are adhesive bonded to and contacted with the electrodes of the semiconductor device.

The metal balls in contact with the electrodes is clearly illustrated in Figs. 2, 4C, 5 and 6B. Note that the metal balls contacting the electrodes in Figs. 2, 4C, 5 and 6B have a spherical shape and thus have not been reflowed.

With reference to a preferred embodiment disclosed in the specification at page 10, line 32 to page 11, line 2, and illustrated in Fig. 6B, the solder balls 53 are contacted with the respective electrodes 52.

New matter is not being presented by the amendment to independent claims 16 and 17.

Drawings

The drawings were objected to under 37 C.F.R. §1.83(a). The Office Action maintained that the metal balls bonded to the electrode with a flux must be shown in the drawings.

Attached hereto is a sketch of Fig. 6B marked in red to show flux 54 adhesive bonding the metal ball 53 to electrodes 53.

See discussion of Fig. 6B at page 11, lines 6-9 of the specification where it is disclosed that when electrodes 52 is coated with a flux (not shown in the figure), solder balls 53 are adhesive bonded to the electrodes. The proposed amendment to Fig. 6B shows the flux 54 which was previously identified in the specification as not shown.

The metal ball 53 in Fig. 6B is spherical in shape. Therefore metal ball 53 in Fig. 6B has not been reflowed.

Upon approval of proposed amended Fig. 6B by the Examiner, a replacement sheet for Fig. 6B will be submitted.

Amendment To Specification

The paragraph at page 11, lines 6-13 of the specification has been amended to reflect the proposed amendment to Fig. 6B.

Interview

An Examiner-Initiated Interview Summary was attached to the Office Action to summarize the telephone interview on August 8, 2003.

The summary of the interview on the continuation sheet is generally agreed to.

Cited references U.S. Patent No. 4,490,181 to Juskey, Jr. and U.S. Patent No. 5,470,787 to Greer were discussed in the telephone interview.

U.S. Patent No. 4,490,181 to Juskey, Jr., was the primary reference relied upon by the Examiner at the time of the interview to reject the claims over the prior art. The

rejection of independent claims 16 and 17 under 35 U.S.C. §103(a) was the subject matter discussed in the interview.

In the interview, it was pointed out to the Examiner that the invention of independent claims 16 and 17 was related to only the top half of Fig. 3 of the Juskey reference which illustrates chip carrier 28 and solder ball 30. It was pointed out that the top half of Fig. 3 of Juskey shows solder ball 30 integral or reflowed with chip carrier 28. The solder ball of Fig. 3 of Juskey is not spherical at the area of contact with chip carrier 28. It was pointed out that the top half of Fig. 3 of Juskey does not disclose or suggest solder ball 30 of Juskey only adhesive bonded to chip carrier 28 with a flux without reflowing. It was pointed out that the secondary reference to Greer does not cure this lack of disclosure in Juskey.

In the Office Action mailed August 13, 2003, U.S. Patent No. 4,490,181 to Juskey, Jr. was not relied up to reject the claims over the prior art.

§112, ¶1

Claims 3-6, 16 and 17 were rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement.

This rejection is respectfully traversed.

The Office Action states at page 3 that "In claims 16 and 17, the phrase **the metal balls are only adhesive bonded to the electrodes with a flux** is not supported in the specificaion".

The applicants maintain that the emphasized phrase is fully supported by the disclosure of the specification.

The Office Action goes to state at page 3:

Furthermore, on page 6 lines 17-24, applicant states that preferable a flux is used to adhesively bond the electrode to the metal ball. No where in the specification can one find that **only** the flux is used to adhesive bond the metal ball.

The Office Action appears to be taking the position that the applicants cannot claim the preferred embodiment of their invention. Stated otherwise, the Office Action appears to be taking the position that the applicants are obligated to claim more than the preferred embodiment of their invention. No authority is known for this position which the Office Action appears to be taking.

The operable sentence is at page 6, lines 17-18 of the specification which reads "A flux is preferably used for adhesive bonding the solder ball to the electrode."

(Emphasis added). The instruction to one skilled in the art as to the preferred practice of the present invention is clear and unambiguous. A flux is the preferred embodiment for adhesive bonding the solder ball to the electrode. This sentence does not read - a flux plus something else is preferably used for adhesive bonding the solder ball to the electrode -.

It is submitted that the Office Action is attempting to add to the clear written description of the

sentence at page 6, lines 17-18 of the specification subject matter that does not appear in this sentence as a description of the preferred embodiment.

In view of the foregoing, it is respectfully requested that the rejection under 35 U.S.C. §112, first paragraph, be withdrawn.

§103

Claims 16 and 17 were rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 06-333930 to Matsumoto in view of Japan No. 63-117450 to Okuaki and U.S. Patent No. 5,470,787 to Greer.

Claims 3-6 were rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 06-333930 to Matsumoto in view of Japan No. 63-117450 to Okuaki and U.S. Patent No. 5,470,787 to Greer and further in view of U.S. Patent No. 5,656,863 to Yasunaga et al.

These rejections, as applied to the amended claims, are respectfully traversed.

Patentability

The present invention of claims 16 and 17, as amended, claims the feature of the metal ball being adhesive bonded to and contacted with the electrode.

Matsumoto discloses a method for adhering balls to electrodes by rolling the balls on a wafer. According to Matsumoto, in fact, the ball is adhered to the electrode through a flux provided on the electrode, and the ball is not

in contact with the electrode, as shown in the illustration of Attachment A attached hereto.

In contrast, in the invention of the present application, the ball is adhesive bonded to and contacted with the electrode, as seen in the illustration of attached Attachment A.

Okuaki relates to a method for providing reflowed bump electrodes having a uniform height. The method of Okuaki is directed to the mounting of a semiconductor device on a film carrier (TAB, Tape Automated Bonding), as referred to on the first page, the right column, line 9 to 11. In Okuaki, the bump used is not spherical, and a flux is applied onto the bump (page 3, the upper right column, lines 13 to 16), and not as an adhesive bond between the bump and a semiconductor chip on which the bump is formed. The flux in Okuaki does not adhesive bond the bump to the semiconductor chip.

In the case of the invention of the present application, the metal ball has not yet been reflowed and melted. The mounting process, which results in the product of the invention of the present application, is totally different from the mounting process in Okuaki. The metal ball of the present invention, which is not reflowed, is adhesive bonded to the electrode with the flux.

Greer uses evaporation for the formation of bumps. The bump becomes a dome-like (ball-like) shape after reflowing. The bump is not bonded to an electrode of a chip

with a flux. Thus, the technical idea of Greer is totally different from the invention of the present application.

Accordingly, the present invention of amended claims 16 and 17 of the present application is not disclosed or suggested to a person with ordinary skill in the art from the disclosures of the three references cited by the Office Action.

The Office Action has further rejected claims 3 to 6, on the grounds that the invention of these claims is unpatentable over Matsumoto (JP 6-333930), Okuaki (JP 63-117450) and Greer (US 5,470,787), and further in view of Yasunaga et al. (US 5,656,863).

Claims 3 to 6 directly or indirectly depend from claims 16 and 17, and therefore cannot be rejected under 35 U.S.C. §103(a), for the reasons set forth above. The applicants thus submit that the rejection of claims 3 to 6 should be withdrawn.

Furthermore, the applicants have the following comments on Yasunaga et al.

Yasunaga et al. relates to the formation of a complicated electrode structure. The portions indicated by the Office Action describe a process for the formation of stacked electrodes, in which the solder layer (layer 8) is formed by a vapor deposition method (column 17, lines 9-15). This is essentially different from the formation of the electrode structure including the metal ball adhesive bonded

to the underlying electrode body with a flux in the invention of the present application.

In the invention of the present application, the metal ball is bonded by a flux to the top layer of electrode. The ball is later melted and further bonded to the top layer using the function of the flux during reflowing of the ball. In contrast, during the vapor deposition for the formation of the solder layer in the Yasunaga reference, the solder layer is melted in the absence of a flux bonding the deposited metal material and the top layer of the electrode. As such, Yasunaga approaches the stability of the junction between the low-melting metal (solder) and the top layer of the electrode in a way totally different from the invention of the present application. Further, Yasunaga is silent on the use of a flux to bond a metal ball, which is not reflowed and is thus not melted, to the top of the electrode, for the subsequent formation of a bump by reflowing.

It is therefore submitted that independent claims 16 and 17, and claims 3-6 dependent thereon, are patentable over Japan No. 06-333930 to Matsumoto in view of Japan No. 63-117450 to Okuaki and U.S. Patent No. 5,470,787 to Greer and/or U.S. Patent No. 5,656,863 to Yasunaga et al.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the present amendment be entered and the application, as amended, be allowed and passed to issue.

Respectfully submitted,

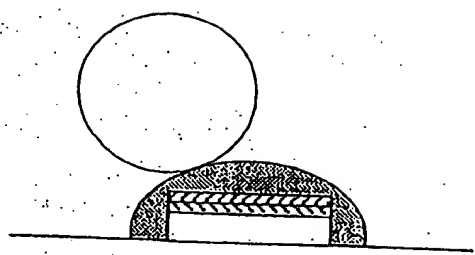
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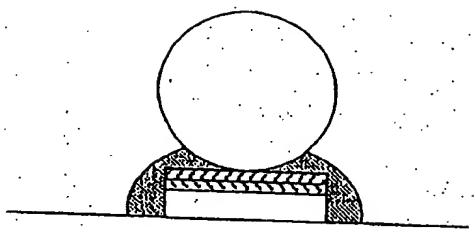
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ATTACHMENT A



MATSUMOTO



THE INVENTION



4/4

Fig.5

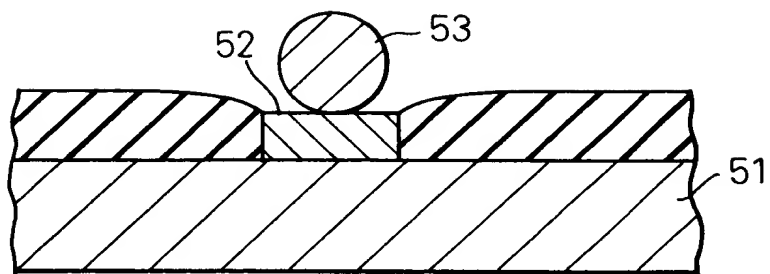


Fig.6A

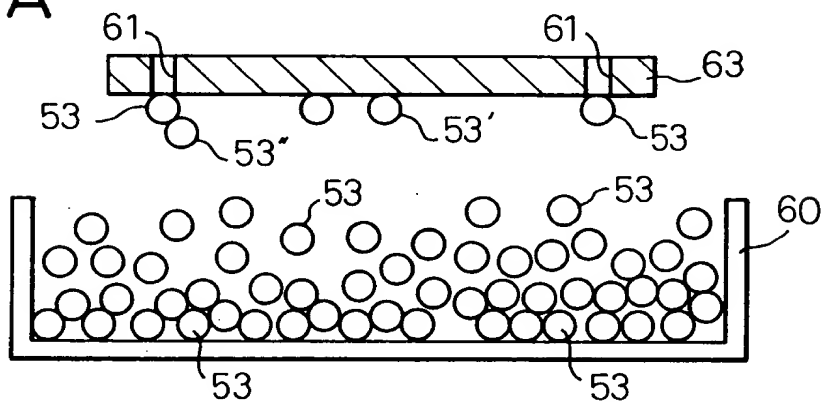


Fig.6B

